DRUM TYPE WASHING AND DRYING MACHINE

Field of the Invention

The present invention relates to a drum type washing and drying machine executing washing, rinsing, dewatering and drying processes in a rotary drum.

Background of the Invention

Referring to Fig. 11, there is illustrated a drum type washing and drying machine. The configuration thereof will now be described hereinafter.

As shown in Fig. 11, housing 1 accommodates therein water tub 4 supported by a plurality of suspensions 2 and dampers 3. The opening of water tub 4 is opened and closed by door 5. Rotary drum 6 having a generally slanted rotation axis is rotatably mounted in water tub 4, and a number of water passing holes 7 and baffles (or vanes) 8 are provided in rotary drum 6.

Water supply valve for washing operation (water supply means, referred to as washer water valve hereinafter) 9 and water supply valve for drying operation (referred to as dryer water valve hereinafter) 10 are installed in housing 1. Water outlet 11 provided at water tub 4 communicates with

drain pump (drain means) 12 via drain pipe 13. Blower 15 functioning to blow air into water tub 4 through air injection opening 14, heater 16 in communication with blower 15, and heat exchanger 17 in communication with water tub 4 and blower 15 constitute a drying air circulation path. Water supply hose 18 supplies water from dryer water valve 10 to heat exchanger 17.

A washing and drying operation of the above described washing and drying machine will now be described hereinafter. Upon initiating washing operation with laundry articles loaded into rotary drum 6, washer water valve 9 is opened to fill fresh water in water tub 4 up to a predetermined water level. Next, rotary drum 6 is driven to rotate at about, e.g., 50 r/min, and the loaded laundry articles are subject to repeated lift-up and drop motions by baffles 8 and are washed by washing fluid with the aid of impact of dropping on a surface of the water.

Upon termination of the washing operation, the washing fluid is drained through drain pipe 13 by driving drain pump 12. After finishing the water draining operation, the laundry articles are dewatered by rotating rotary drum 6 at a high rotation speed of about 1000 r/min. The dewatering operation is followed by the drying operation.

In the drying operation, rotary drum 6 is driven to rotate to enable the laundry articles therein to move up and

down as in the washing operation and, at the same time, hot air heated by heater 16 is supplied to the laundry articles in rotary drum 6 by blower 15 through air injection opening 14, so that moisture in the laundry article is heated and evaporated therefrom.

The hot air containing therein water vapor is directed to heat exchanger 17; and then the hot air is cooled down and dehumidified by the heat exchange process induced by way of being mixed with the cooling water provided from dryer water valve 10 to heat exchanger 17. The drying operation of laundry articles is executed, as the dehumidified air is re-heated by heater 16 and re-directed into rotary drum 6, which constitutes a series of drying cycles.

In such prior art configuration described above, implementation of the drying air circulation path inside housing 1 having restricted dimensions produces certain problems, in that it is difficult to secure required gap between housing 1 and water tub 4 and that the heat exchanger 17 may not be configured to have an enough cross sectional area to confer required drying performance.

Further, heat exchange in such heat exchanger 17 is carried out by uniformly dispersing the cooling water within the space of heat exchanger 17 with the aid of a wind pressure of the circulating air. Thus, if the amount of circulating air is increased too much in order to improve

the drying efficiency, the wind pressure inside heat exchanger 17 having a narrow cross sectional shape will be increased excessively. Consequently, the balance between the wind pressure and the aerially scattered cooling water is disturbed, and thus the cooling water is driven to fly upwards to reach heater 16 so that the drying efficiency is degraded considerably.

Moreover, in case of drying clothes having long fibers or pet hairs attached thereon, heat exchanger 17 may be clogged, leading to a failure of the drying operation.

Summary of the Invention

It is, therefore, an object of the present invention to provide a drum type (or front-loading) washing and drying machine capable of performing a dehumidification process by way of utilizing a large inner space of a water tub, without building a separate heat exchanger at the outside thereof, to thereby improve the dehumidification efficiency and at the same time prevent the occurrence of the prior art problems of the flying-back of cooling water and the clogging-up of the heat exchanger owing to the accumulation of lint, etc.

In accordance with the present invention, there is provided a drum type washing and drying machine including: a

rotary drum; a water tub including therein the rotary drum; a water supply member for supplying cooling water into the water tub; a heater for heating air; a blower for blowing the heated air into the water tub to evaporate moisture from laundry articles in the water tub; and a dehumidification means for cooling and dehumidifying air containing the evaporated moisture by the cooling water, wherein the dehumidification means is provided in a space between the water tub and the rotary drum.

Brief Description of the Drawings

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a partially cutaway cross sectional view of a drum type washing and drying machine in accordance with a first preferred embodiment of the invention;

Fig. 2 shows a cross sectional view of a main part of a drum type washing and drying machine in accordance with a second preferred embodiment of the invention;

Fig. 3 illustrates a partially cutaway perspective view of a main part of a drum type washing and drying machine in accordance with a third preferred embodiment of

the invention;

Fig. 4 depicts a partially exploded perspective view of a main part of a drum type washing and drying machine in accordance with a fourth preferred embodiment of the invention;

Fig. 5 presents a partially cutaway perspective view of a main part of a drum type washing and drying machine in accordance with a fifth preferred embodiment of the invention;

Fig. 6 sets forth a front view of a main part of a drum type washing and drying machine in accordance with a sixth preferred embodiment of the invention;

Fig. 7 describes a cross sectional view of a main part of a drum type washing and drying machine in accordance with a seventh preferred embodiment of the invention;

Fig. 8 represents a cross sectional view of a main part of a drum type washing and drying machine in accordance with an eighth preferred embodiment of the invention;

Fig. 9 outlines a cross sectional view of a main part of a drum type washing and drying machine in accordance with a ninth preferred embodiment of the invention;

Fig. 10 provides a cross sectional view of a main part of a drum type washing and drying machine in accordance with a tenth preferred embodiment of the invention; and

Fig. 11 gives a vertical cross sectional view of a

prior art drum type washing and drying machine.

Detailed Description of the Preferred Embodiments

The preferred embodiments of the invention will now be described hereinafter by referring to Fig. 1 to 10, wherein like parts to those of the prior art washing and drying machine are designated with like reference numerals, and descriptions thereof will be omitted.

(Embodiment 1)

As shown in Fig. 1, rotary drum 6 having a generally slanted rotation axis is rotatably mounted in water tub 4. Dryer water valve (water supply means) 10 communicates with the inner space of water tub 4 via water supply hose 19; and nozzle 20 is mounted at an end of water supply hose 19. Nozzle 20 is opened to the space between water tub 4 and rotary drum 6 (referred to as inter-space hereinafter), so that the cooling water is provided thereto and thus the moisture evaporated from laundry articles in water tub 4 can be dehumidified by the thus supplied cooling water.

A drying operation of the above configuration will now be described. In the drying operation, driving rotary drum 6 mingles the laundry articles in rotary drum 6 in a similar

manner as in the washing operation. As blower (blow means) 15 directs hot air heated by heater (heating means) 16 to the laundry articles in rotary drum 6 through air injection opening 14, moisture contained in the laundry articles is heated and evaporated. The vapor-including hot or heated air is directed into the inter-space through water passing holes 7 provided on rotary drum 6.

The cooling water, directed from dryer water valve 10 to nozzle 20 through water supply hose 19, is provided to the inter-space. The vapor-including hot air in the inter-space is cooled down and dehumidified by the heat exchange process taking place with the cooling water. The drying operation of laundry articles is executed, as the dehumidified air is re-heated by heater 16 and re-directed into rotary drum 6. Thus, a series of drying cycles is performed.

In accordance with the first embodiment of the present invention, the efficiency of dehumidification can be improved, by way of executing a dehumidification in the large inter-space, instead of providing a separate heat exchanger at the outside of water tub 4. At the same time, the reverse flow or flying back of the cooling water and the clogging of the lint or fur may be reduced or prevented.

The present embodiment has been described with respect to rotary drum 6 rotatably mounted in water tub 4 with a

slanted rotation axis by a certain degree. However, substantially identical results can be achieved with rotary drum 6 rotatably mounted in water tub 4 with a horizontal or a substantially horizontal rotation axis. Further, as for the dehumidification, the inner wall of water tub 4 may be designed to serve as a radiator (in which the cooling water flows along predetermined water paths) in place of the above-described configuration, in which the cooling water is supplied into the inter-space to flow down along the inner wall of water tub 4.

(Embodiment 2)

As shown in Fig. 2, cooling nozzles 21 having a plurality of water supply holes 22 opened in water tub 4 are mounted on a surface of a wall of water tub 4 and communicates with dryer water valves 10 through water supply hoses 23. Dehumidification is executed by flowing the cooling water along the inner wall of water tub 4 through water supply holes 22 of cooling nozzles 21. The rest of the configuration is substantially the same as in the above-described embodiment.

An operation of the above-described configuration will now be described hereinafter. In the drying operation, the cooling water is directed from dryer water valves 10 to

cooling nozzles 21 through water supply hoses 23. The cooling water, provided from the plurality of water supply holes 22 through cooling nozzles 21, flows downward to cool the inner wall of water tub 4, so that the vapor-including hot air in water tub 4 is cooled down and dehumidified by executing the heat exchange upon coming into contact with the cooled inner wall of water tub 4. The drying operation of laundry articles is executed, as the dehumidified air is also re-heated by heater 16 and re-directed into rotary drum 6. Thus, a series of drying cycles is performed.

In accordance with the second embodiment of the present invention, the reverse flowing of the cooling water and the clogging of the lint, etc. may be reduced or eliminated, without having to provide a separate heat exchanger at the outside of water tub 4, by way of performing the dehumidification at the large inner wall of water tub 4.

(Embodiment 3)

As shown in Fig. 3, cooling nozzle (passing waterway for the cooling water) 24 for flowing the cooling water and water tub 4 are molded in one body. Cooling nozzle 24 communicates with dryer water valve 10 through water supply hose 23 and is provided with a plurality of water supply

holes 22 opened in water tub 4. The rest of the configuration is substantially the same as in the above-described embodiments 1 and 2.

An operation of the above-described configuration will now be described hereinafter. In the drying operation, the cooling water is directed from dryer water valve 10 to cooling nozzle 24 through water supply hose 23. The cooling water provided from the plurality of water supply holes 22 through cooling nozzle 24 flows downward to cool down the inner wall of water tub 4, so that the vapor-including hot air in water tub 4 is cooled down and dehumidified by executing a heat exchange upon coming into contact with the cooled inner wall of water tub 4. The drying operation of laundry articles is executed, as the dehumidified air is re-heated by heater 16 and re-directed into rotary drum 6. Thus, a series of drying cycles is performed.

In accordance with the third embodiment, the efficiency of dehumidification can be improved, by efficiently providing the cooling water to the inner wall of water tub 4 through a simple configuration of cooling nozzle 24 and water tub 4 molded in one body. Further, since such configuration does not require additional parts in installing the nozzle, the cost can be reduced.

(Embodiment 4)

As shown in Fig. 4, cooling nozzle (passing waterway for the cooling water) 25 for flowing the cooling water is detachably installed to mounting hole 26 provided on a wall of water tub 4 by being inserted thereto via packing 27. Cooling nozzle 25 communicates with dryer water valve 10 through water supply hose 23. The rest of the configuration is substantially the same as in the above described first to third embodiments.

An operation of the above-described configuration will now be described hereinafter. In the drying operation, the cooling water, directed from dryer water valve 10 to cooling nozzle 25 through water supply hose 23 flows down to cool down the inner wall of water tub 4, so that the vapor-including hot air in water tub 4 is cooled down and dehumidified by executing the heat exchange upon coming into contact with the cooled inner wall of water tub 4. The drying operation of laundry articles is executed as the dehumidified air is re-heated by heater 16 and re-directed into rotary drum 6. Thus, a series of drying cycles is performed.

In accordance with the fourth embodiment, by detaching cooling nozzle 25 when clogged, maintenance and repair can easily be carried out to perform e.g. internal cleaning or

exchanging with other cooling nozzle.

(Embodiment 5)

As shown in Fig. 5, cooling nozzles (passing waterways for the cooling water) 28, 29, 30 for flowing the cooling water respectively include water supply holes 22 opened in water tub 4. Cooling nozzles 28, 29, 30 respectively communicate with dryer water valves 34, 35, 36 through water supply hoses 31, 32, 33, providing respective passing waterways. The rest of the configuration is substantially the same as in the above-described first embodiment.

An operation of the above configuration will now be described hereinafter. In the drying operation, the cooling water, directed from dryer water valves 34, 35, 36 to cooling nozzles 28, 29, 30 through water supply hoses 31, 32, 33, flows downward to cool down an inner wall of water tub 4. The vapor-including hot air in water tub 4 is cooled down and dehumidified by executing a heat exchange upon coming into contact with the cooled inner wall of water tub 4.

In this case, the water can be sequentially diverted to cooling nozzles 28, 29, 30 by utilizing dryer water valves 34, 35, 36, so that the larger surface of the inner wall of water tub 4 can be utilized for the heat exchange without increasing the overall flow rate of the cooling

water, enabling an efficient dehumidification to be executed.

In accordance with the fifth embodiment, water can be sequentially diverted to cooling nozzles 28, 29, 30 by manipulating dryer water valves 34, 35, 36. Thus, the inner wall of water tub 4 can be efficiently cooled down while conserving water such that the efficiency of dehumidification can be improved.

(Embodiment 6)

As shown in Fig. 6, cooling nozzles (passing waterways for the cooling water) 36, 37 for flowing the cooling water respectively are mounted on a surface of a wall of water tub 4. Cooling nozzles 36, 37 communicate with dryer water valve 41 through branch pipe 38 and water supply hoses 39, 40. Since water supply routes toward cooling nozzles 36, 37 are provided at the same height (H) from a horizontal plane, each head becomes equivalent. The term "head" as used herein represents the height of the branch pipe and the water supply route from a corresponding nozzle and thus is related to the amount of cooling water being supplied. The rest of the configuration is substantially the same as in the above-described first embodiment.

An operation of the above configuration will now be described hereinafter. In the drying operation, the cooling

water, directed from dryer water valve 41 to cooling nozzles 36, 37 through branch pipe 38 and water supply hoses 39, 40, flows downward to cool down the inner wall of water tub 4, so that the vapor-including hot air in water tub 4 is cooled down and dehumidified by executing a heat exchange upon coming into contact with the cooled inner wall of water tub 4.

In this case, as water supply route toward cooling nozzles 36, 37 is provided at the same height (H) from a horizontal plane, each head becomes equivalent. Therefore, the same amount of water can be supplied to cooling nozzles 36, 37 to thereby enable the heat exchange to be performed uniformly with a predetermined amount of water supply.

In accordance with the sixth embodiment, as water supply route toward cooling nozzles 36, 37 is provided at the same height (H) from a horizontal plane, each head becomes equivalent such that the equal amount of cooling water flows through cooling nozzles 36, 37.

(Embodiment 7)

As shown in Fig. 7, dehumidification is carried out by utilizing cooling nozzles 40 for flowing the cooling water, which makes the cooling water flow in a bottom half portion of a surface of an inner wall of water tub 4, below rotation

axis (S). The rest of the configuration is substantially the same as in the above-described first embodiment.

An operation of the above configuration will now be described hereinafter. In the drying operation, the cooling water, directed from dryer water valves 10 to cooling nozzles 40 through water supply hoses 23, flows downward to cool down the inner wall of water tub 4, so that the vapor-including hot air in water tub 4 is cooled down and dehumidified by executing the heat exchange upon coming into contact with the cooled inner wall of water tub 4.

In this case, the dehumidification process is carried out by utilizing cooling nozzles 40, which makes the cooling water flow in a bottom half portion below rotation axis (S) on the surface of the inner wall of water tub 4. Thus, in spite of a simple configuration in which the cooling water flows down naturally from cooling nozzles 40, the bottom half portion on the surface of the inner wall of water tub 4 serves as a heat exchanger.

(Embodiment 8)

As shown in Fig. 8, cooling nozzles 21 having water supply holes 22 opened in water tub 4 are mounted on a surface of a wall of water tub 4 and communicate with dryer water valves 10 through water supply hoses 23. The

dehumidification is executed by flowing the cooling water along the inner wall of water tub 4 from water supply holes 22 of cooling nozzles 21. The inner wall of water tub 4 is provided with an uneven surface configuration having a plurality of prominences and depressions, which are prepared by graining, for example. The rest of the configuration is substantially the same as in the above described first or second embodiment.

An operation of the above configuration will now be described hereinafter. In the drying operation, the cooling water is directed from dryer water valves 10 to cooling nozzles 21 through water supply hoses 23. The cooling water, provided from water supply holes 22 through cooling nozzles 21, flows down to cool down the inner wall of water tub 4, so that the vapor-including hot air in water tub 4 is cooled down and dehumidified by executing a heat exchange process upon coming into contact with the cooled inner wall of water tub 4.

In this case, a number of prominences and depressions formed on the surface of the inner wall of water tub 4 facilitates the spreading of the cooling water, and increases the surface area to be utilized for the heat exchange process, thereby rendering a more efficient heat exchange.

(Embodiment 9)

As shown in Fig. 9, cooling nozzle 43 for flowing the cooling water is mounted on an upper part of a surface of an outer wall of water tub 4. Cooling nozzle 43 communicates with water path 44, which is provided with opening 45 opened toward the inner space of water tub 4. Cooling water flows continuously from the surface of the outer wall to the surface of the inner wall of water tub 4 to thereby execute the dehumidification. The rest of the configuration is substantially the same as in the above-described first embodiment.

An operation of the above configuration will now be described hereinafter. In the drying operation, the cooling water is directed from dryer water valve 10 to cooling nozzle 43 through water supply hose 23. The cooling water flows down along the surface of outer wall through water path 44; and then flows to the surface of the inner wall of water tub 4 via opening 45, thereby continuously flowing downward to cool down the inner wall of water tub 4. The vapor-including hot air in water tub 4 is cooled down and dehumidified by executing the heat exchange upon coming into contact with the cooled inner wall of water tub 4.

In this case, the inner wall surface throughout the upper and lower parts of water tub 4 can be used as the

surface at which heat exchange takes place, increasing the heat exchange surface area. Thus, the capacity of the dehumidification becomes higher thereby rendering a more efficient heat exchange. In a similar manner, the capacity of dehumidification can be even more increased by utilizing both of the lateral surfaces (i.e., the whole surface of the inner side wall) and rear surface of water tub 4 as the heat exchange surface.

(Embodiment 10)

As shown in Fig. 10, cooling nozzles (passing waterways for the cooling water) 46, 47 for respectively flowing the cooling water are mounted on a surface of a wall of water tub 4. Cooling nozzles 46, 47 communicate with through water supply hoses 48, 49. Dryer water valves 50, 51 are configured to be switched according to the drying conditions of laundry articles. The rest of the configuration is almost identical as in the above-described first embodiment.

An operation of the above configuration will now be described hereinafter. In the drying operation, the cooling water, directed from dryer water valves 50, 51 to cooling nozzles 46, 47 through water supply hoses 48, 49, flows downward such that the inner wall of water tub 4 is cooled

down. The vapor-including hot air in water tub 4 is cooled down and dehumidified by executing the heat exchanging upon coming into contact with the cooled inner wall of water tub 4.

After the preheating period of drying operation, i.e., in the middle of the drying operation when the humidity is increased in water tub 4, water is supplied through dryer water valves 50, 51 to both cooling nozzles 45, 47, such that the dehumidification by water cooling is executed with a large cooling surface of the inner wall of water tub 4. If the humidity in water tub 4 is decreased during the latter period of drying operation, the water cooling is executed through only one cooling nozzle.

In accordance with the tenth embodiment, for the period of drying operation during which vapor evaporation vigorously takes place from the laundry articles, the dehumidification by water cooling can be executed efficiently. For the latter period of drying operation, the water cooling is executed, e.g., just enough to restrain an excessive rise of temperature of laundry articles, so that water consumption can be decreased and the running cost can be reduced.

As described above, in accordance with the present invention, air is cooled down and dehumidified at the inter-space between the water tub and the rotary drum by the

cooling water, without installing a separate heat exchanger at the outside of the water tub. Therefore, dehumidification can be performed efficiently in a large space within the water tub and, at the same time, the prior art problems, e.g., the reverse flow of the cooling water due to wind pressure and the clogging of heat exchanger due to the accumulation of lint, etc. can be prevented.

While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.